

C L A I M S

What is claimed and desired to be secured by Letters Patent is as follows:

1. A polyaxial head bone screw assembly for surgical implantation and comprising:
 - (a) a shank having a threaded body adapted to be implanted in a bone and a capture end;
 - (b) a head having a channel adapted to receive a rod within said channel, said head having a bore formed therethrough;
 - (c) said capture end of said shank being operably received within said shank receiving bore of said head;
 - (d) a retainer ring secured on said capture end of said shank within said head to retain said capture end within said head and enabling selective angular positioning of said shank with respect to said head, while in an adjustment configuration; and
 - (e) a closure member operably received in said head in such a manner as to be adapted to engage a rod located within said channel and to urge the rod

into engagement with said capture end of said shank in such a manner so as to fixedly position said head relative to such a rod and to secure said head from angular movement relative to said shank, when in a locking configuration.

2. An assembly as set forth in Claim 1 wherein:

(a) said retainer ring has an outer surface, of which at least a portion is substantially spherical.

3. An assembly as set forth in Claim 2 wherein:

(a) said head has a seating surface, of which at least a portion is substantially spherical and that is sized and positioned to enable slidable mating engagement with said retainer outer surface, when in the adjustment configuration, and that frictionally resists relative movement, when in the locking configuration.

4. An assembly as set forth in Claim 1 wherein:

(a) said capture end of said shank has a frusto-conical surface diminishing in diameter toward said shank.

5. An assembly as set forth in Claim 4 wherein:
 - (a) said retainer ring has a frusto-conical retainer bore formed therethrough to enable mating engagement with said capture end within said retainer bore.
6. An assembly as set forth in Claim 1 wherein:
 - (a) said retainer ring has a separation to enable resilient expansion and contraction of a diameter of said retainer ring.
7. An assembly as set forth in Claim 1 wherein:
 - (a) said retainer ring has a substantially radial split to enable resilient expansion and contraction of a diameter of said retainer ring.
8. An assembly as set forth in Claim 1 wherein:
 - (a) said capture end of said shank has a non-slip formation to enable non-slip engagement with a rod within said channel of said head.
9. An assembly as set forth in Claim 1 wherein:
 - (a) said capture end of said shank has a knurled dome to enable non-slip engagement with a rod within said channel of said head.

10. An assembly as set forth in Claim 1 wherein:

- (a) said capture end of said shank has a tool formation to enable non-slip engagement by a tool.

11. An assembly as set forth in Claim 1 wherein:

- (a) said head has an internal guide and advancement structure formed therein; and
- (b) said closure member has a radially outward surface with an external guide and advancement structure formed thereon which is sized and shaped to rotatably mate with said internal guide and advancement structure of said head.

12. An assembly as set forth in Claim 1 wherein:

- (a) said head has an internal thread formed therein; and
- (b) said closure member has a radially outward surface with an external thread formed thereon which is configured to rotatably mate with said internal thread of said head.

13. A polyaxial head bone screw assembly for surgical implantation and comprising:

- (a) a shank having a threaded body and a capture end;
- (b) a head having a channel outwardly open and adapted to receive a rod within said channel; said head having shank mating side with a shank receiving bore formed therethrough; head having a cavity therein open into said bore;
- (c) said capture end of said shank being received within said shank receiving bore of said head;
- (d) a retainer ring with a split therein to enable resilient expansion and contraction of a diameter of said retainer ring; said retainer ring being received in said head cavity and resiliently receiving said capture end of said shank while within said cavity so as to retain said capture end within said head and enabling selective angular positioning of said shank with respect to said head when in an assembly configuration; and
- (e) a closure member operably mountable within said head in such a manner as to close said channel and adapted to engage a rod within said channel so as to urge said rod into direct engagement with said capture end of said shank in such a manner as to

secure said head from movement relative to such a rod and to secure said head from angular movement relative to said shank in a locking configuration.

14. An assembly as set forth in Claim 13 wherein:

- (a) said retainer ring has an outer surface, of which at least a portion is substantially spherical; and
- (b) said head cavity has inner surface, of which at least a portion is substantially spherical to enable mating engagement with said outer surface of said retainer.

15. An assembly as set forth in Claim 13 wherein:

- (a) said capture end of said shank has a frusto-conical surface diminishing in diameter toward said shank; and
- (b) said retainer ring has a frusto-conical retainer bore formed therethrough to enable mating engagement with said capture end within said ring bore.

16. An assembly as set forth in Claim 13 wherein:
 - (a) said retainer ring has a substantially radial split to enable resilient expansion and contraction of a diameter of said retainer ring.
17. An assembly as set forth in Claim 16 wherein:
 - (a) said cavity has a first region having a partial hemispherical surface sized and shaped to mate with a partial hemispherical surface on said retainer ring; and
 - (b) said cavity has a second region directly accessible from said first region and having a larger radius than said first region wherein said ring is expandable as it joins with said shank.
18. An assembly as set forth in Claim 13 including:
 - (a) a knurled dome formed on said capture end of said shank with a non-slip formation.
19. An assembly as set forth in Claim 13 wherein:
 - (a) said capture end of said shank has a tool formation adapted to enable engagement by a tool for rotation.

20. An assembly as set forth in Claim 13 wherein:

- (a) said head has an internal guide and advancement structure formed therein; and
- (b) said closure member has a radially outward surface with an external guide and advancement structure formed thereon which is sized and shaped to rotatably mate with said internal guide and advancement structure of said head.

21. An assembly as set forth in Claim 13 wherein:

- (a) said head has an internal mating structure formed therein; and
- (b) said closure member has a radially outward surface with an external mating structure formed thereon which is configured to rotatably mate with said internal mating structure of said head.

22. In a polyaxial head bone screw assembly for surgical implantation and including a shank having a threaded body and a capture end and a head having an outward opening channel open adapted to receive a rod within said channel, said head having with a shank receiving bore formed therethrough, the improvement comprising:

- (a) said capture end of said shank being received within said shank receiving bore of said head;
- (b) a retainer ring resiliently retained on said capture end of said shank on a side of said bore opposite said shank body within said head to retain said capture end within said head and enabling selective angular positioning of said shank with respect to said head; and
- (c) a closure member operably engageable with said head and adapted to engage a rod within said channel so as to be adapted to urge the rod into direct engagement with said capture end of said shank to produce friction between said ring and head as to secure said head from movement relative to such a rod and to secure said head from angular movement relative to said shank in a locking configuration.

23. An assembly as set forth in Claim 21 wherein:

- (a) said retainer ring has an outer surface, of which at least a portion is substantially spherical; and
- (b) said head has a cavity with an inner surface, of which at least a portion is substantially spherical and sized and shaped to enable mating engagement with said outer surface of said retainer.

24. An assembly as set forth in Claim 21 wherein:

- (a) said capture end of said shank has a frusto-conical surface diminishing in diameter toward said shank; and
- (b) said retainer ring has a frusto-conical retainer bore formed therethrough to enable mating engagement with said capture end within said retainer bore upon expansion of said ring with said ring returning to an original diameter after placement on said shank.

25. An assembly as set forth in Claim 21 wherein:

- (a) said retainer ring has a radial split to enable resilient expansion and contraction of a diameter of said retainer ring.

26. An assembly as set forth in Claim 21 wherein:

(a) said cavity has an expansion chamber above said head spherical surface that allows expansion of said ring therein as said shank is inserted into said ring.

27. An assembly as set forth in Claim 21 wherein:

(a) said capture end of said shank has a dome formation to enable non-slip engagement with a rod within said channel of said head.

28. An assembly as set forth in Claim 21 wherein:

(a) said capture end of said shank has a knurled and radiused dome adapted to enable non-slip engagement with a rod within said channel of said head.

29. An assembly as set forth in Claim 21 wherein:

(a) said capture end of said shank has a tool formation so as to be adapted enable non-slip engagement by a tool.

30. An assembly as set forth in Claim 21 wherein:

- (a) said head has an internal guide and advancement structure formed therein; and
- (b) said closure member has a radially outward surface with an external guide and advancement structure formed thereon which is sized and shaped to rotatably mate with said internal guide and advancement structure of said head.